

Compliance 101



Federal Aviation
Administration



Presentation to: National Software/CEH Conference
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Date: July 2005

Compliance 101

Agenda

- Regulations and the legal system
- Determining what a specific regulation really means
- Responsibilities of the FAA and the applicant
- How I know I have shown compliance?
- The ideal certification program



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US Constitutional Process

Article I - Legislative Branch/Congress passes law–

- Results in Statutory Law (United States Code)
- Delegates to Executive Agencies the authority to promulgate regulations based on statutes

Article II - Executive Branch concurs/executes law

- Presidential Veto
- Executive branch enforces law. (Cabinet – DOT – FAA)
- Promulgate regulations (when authorized by Congress)

Article III - Judicial Branch interprets law by resorting to

1. Statutes and legislative history,
2. Regulations, and
3. Case law.



Constitutional Basis for Aviation Compliance

Congress makes laws

- Delegates FAA the authority to promulgate regulations to promote safe flight

Executive branch enforces laws

- Promulgate and enforces Aviation Safety regulations

Judicial branch interprets laws

- Judicial authorities only get involved in settling disputes.

Judicial Branch Interprets Laws

- Judicial authorities primarily get involved in settling disputes.
- Judicial branch is very involved in compliance and enforcement cases.
- Normally not involved prior to TC
- However, “Judicial Activism”



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Congress Makes Laws

- Congress has given the FAA the authority to promote safe flight by:
 - Conducting investigations,
 - Prescribing:
 - Regulations,
 - Standards,
 - Procedures,
 - Issuing orders
 - Issuing type certificates



Congress Authorizes FAA

US CODE

TITLE 49 – TRANSPORTATION

SUBTITLE VII - AVIATION PROGRAMS

PART A - AIR COMMERCE AND SAFETY

subpart I – general

CHAPTER 401 - GENERAL PROVISIONS

Sec. 40113. Administrative

subpart III – safety

CHAPTER 447 - SAFETY REGULATION

Sec. 44701. General requirements

**Sec. 44704. Type certificates, production certificates,
and airworthiness certificates**

Current as of 01/06/03



49 USC Sec. 40113 Administrative

- (a) General Authority. - The Administrator of the Federal Aviation Administration may take action the Administrator considers necessary to carry out this part, including
 - conducting investigations,
 - prescribing regulations,
 - standards, and procedures,
 - and issuing orders.



49 USC Sec. 44701 General Requirements

- (a) Promoting Safety. - The Administrator of the Federal Aviation Administration shall promote safe flight of civil aircraft in air commerce by prescribing -
- (1) minimum standards required in the interest of safety for appliances and for the design, material, construction, quality of work, and performance of aircraft, aircraft engines, and propellers;
 - (5) regulations and minimum standards for other practices, methods, and procedure the Administrator finds necessary for safety in air commerce and national security.



49 USC Sec. 44704 Type Certificates, Production Certificates, and Airworthiness Certificates

(a) Type Certificates. -

(1) The Administrator of the Federal Aviation Administration shall issue a type certificate for an aircraft, aircraft engine, or propeller, or for an appliance specified under paragraph (2)(A) of this subsection when the Administrator finds that the aircraft, aircraft engine, propeller, or appliance is

- properly designed and manufactured,
- performs properly,
- and meets
- the regulations and
- minimum standards prescribed under section 44701(a) of this title.

49 USC § 44702, Issuance of Certificates, (d) Delegation

- (1) Subject to regulations, supervision, and review the Administrator may prescribe, the Administrator may delegate to a qualified private person, or to an employee under the supervision of that person, a matter related to -
 - (A) the examination, testing, and inspection necessary to issue a certificate under this chapter; and
 - (B) issuing the certificate.
- (2) The Administrator may rescind a delegation under this subsection at any time for any reason the Administrator considers appropriate.
- (3) A person affected by an action of a private person under this subsection may apply for reconsideration of the action by the Administrator. On the Administrator's own initiative, the Administrator may reconsider the action of a private person at any time. If the Administrator decides on reconsideration that the action is unreasonable or unwarranted, the Administrator shall change, modify, or reverse the action. If the Administrator decides the action is warranted, the Administrator shall affirm the action.



Constitutional Basis for Aviation Compliance

Congress makes laws

- Delegates FAA the authority to promulgate regulations to promote safe flight

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Judicial branch interprets laws

- Judicial authorities only get involved in settling disputes

Executive Branch Enforces Laws

Execute: (HQ, Directorate, ACO, MIDO)

Generates: Regulations, Standards, Procedures,
Orders, Type Certificates, Production Certificates,
Delegations

Interprets: (Office of the Chief Counsel)

Given the authority of the Administrator to interpret regulation
for the FAA

Practically speaking, you only end up in court if you don't follow
Counsel's interpretation (unless applicant requests due process
via alternate means or exemption)

Enforces: (Regional Counsel, ACO, MIDO, FSDO)

Legal enforcement, Administrative enforcement, Reviews,
Audits

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Determining What a Specific Regulation Really Means

“Obviously, it is impractical to cover all situations or conditions that may arise and, hence, these instructions must be supplemented by good judgement in handling the particular problems involved.”

FAA Order 8110.4b FOREWORD

What If the Applicant and the ACO Disagree Prior to TC?

- Type certificate applicants can seek a written legal interpretation from FAA legal counsel with regard to the application of a particular regulation to a specific set of facts.
- If ACO personnel have a question about how to apply a particular FAA regulation, legal counsel should be consulted and a legal interpretation obtained.
- Legal normally does not review means of compliance issue papers, but does review exemptions, ELOS and all policy.



If It Does End up in Court?

“When conducting a hearing ... the [NTSB] is ... bound by all validly adopted interpretations of laws and regulations the Administrator carries out and of written agency policy guidance available to the public ... unless the Board finds an interpretation is arbitrary, capricious, or otherwise not according to law.”

49 U.S.C. § 44709(d)(3).

In *FAA v. Merrell* the U.S DC Circuit Court of Appeals includes litigation statements of FAA counsel, as well as citations of case law as binding on the NTSB Court.

How the FAA Is Taught to Interpret a Regulation.

Responsibility lies with the office of chief counsel

Excerpts from FAA compliance & enforcement course
(required class for all FAA engineers and inspectors)

Whenever there is a question concerning the meaning of a regulation,

- First read the regulation,
- And then read the preamble.

If that does not answer the question,

- Request an opinion from regional counsel.
- If the legal office has to research the question, they will review prior written opinions of the chief counsel.
- If a more authoritative opinion is needed, regional counsel will contact the chief counsel in headquarters.

Reading the Regulations

- To understand and properly interpret a regulation, read the regulation while asking these questions:
- Who? What? Where? When? How? Why?
- When reading a regulation
 - Divide each sentence into its operative terms and be sure these elements are understood
 - Then rebuild the sentence



Example: Regulation

- Sec. 21.33 Inspection and tests.
- (a) Each applicant must allow the Administrator to make any inspection and any flight and ground test necessary to determine compliance with the applicable requirements of the Federal Aviation Regulations.



Elements of the Regulation : Sec. 21.33(a)

1. Each applicant (not vendors but the applicant)
2. Must allow (refusal - - letter or record of conversation)
3. The Administrator (reg. 1.1, 13.3, ID shown)
4. To make any inspection (request for inspection)
5. And any flight and ground test (request for test)
6. Necessary to determine compliance (why necessary?)
7. With the applicable requirements of the regulations.

(Which Regs. Applicable? Reg. 21.1)

- You must prove each element to prove a violation.
- Conversely you must examine each element to determine compliance.
- ***Notice every sentence, and phrase is examined!***

Example: Regulation

- Sec. 91.13 Careless or reckless operation.
- (a) *Aircraft operations for the purpose of air navigation.* No person may operate an aircraft in a careless or reckless manner so as to endanger the life or property of another.



Elements of the Regulation: Section 91.13(a)

1. No person (14CFR 1.1 - corporation, partnership, individual)
 2. Shall operate (14CFR 1.1 - use or authorize use)
 3. Aircraft (14CFR 1.1 - balloons, glider, rotorcraft, etc)
 4. Careless or reckless manner (not reasonably prudent or intentional)
 5. Endanger (actual vs. potential)
 6. Life or property (Standard dictionary definition)
 7. Of another
- You must prove each element to prove a violation.
 - Conversely you must examine each element to determine compliance.
 - ***Notice every sentence, and phrase is examined!*** (end excerpt)



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Responsibilities of the FAA and the Applicant

14 CFR Part 21 CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

Sec. 21.17 Designation of applicable regulations.

(a) Except as provided in Sec. 23.2, Sec. 25.2, Sec. 27.2, Sec. 29.2, and in parts 34 and 36 of this chapter, **an applicant** for a type certificate **must SHOW** that the aircraft, aircraft engine, or propeller concerned meets—

- (1) The applicable requirements of this subchapter that are effective on the date of application for that certificate unless--
 - (i) Otherwise specified by the Administrator; or
 - (ii) Compliance with later effective amendments is elected or required under this section; and
- (2) Any special conditions prescribed by the Administrator.

Sec. 21.33 Inspection and tests.

(b) Each **applicant must make ALL inspections and tests necessary** to determine—

- (1) Compliance with the applicable airworthiness, aircraft noise, fuel venting, and exhaust emission requirements;
- (2) That materials and products conform to the specifications in the type design;
- (3) That parts of the products conform to the drawings in the type design; and
- (4) That the manufacturing processes, construction and assembly conform to those specified in the type design.

U.S. Supreme Court

- One example of judicial involvement in deciding Applicant – Owner - FAA responsibility is:

UNITED STATES v. VARIG AIRLINES, 467 U.S. 797 (1984)

- Scenario: Boeing 707 owned by VARIG was flying from Rio de Janeiro to Paris when a fire broke out in one of the aft lavatories. Most of the passengers on board died from asphyxiation or fire induced toxic gases, and most of the plane's fuselage was consumed by the postimpact fire. VARIG alleged that the Civil Aeronautics Agency, the FAA's predecessor, was negligent in issuing a type certificate for the Boeing 707 because the lavatory trash receptacle did not satisfy applicable safety regulations.
- The ruling was based on old CAA regulations and orders but the concepts have been preserved in the new guidance and still apply.

Significant Quotes from U.S. v. Varig

- “The FAA certification process is founded upon a relatively simple notion: the **duty to ensure** that an **aircraft conforms** to FAA safety regulations **lies with the manufacturer and operator**, while **the FAA** retains the responsibility for **policing compliance**. Thus, the manufacturer is required to develop the plans and specifications and perform the inspections and tests necessary to establish that an aircraft design comports with the applicable regulations; the **FAA** then reviews the data for conformity purposes by conducting a **"spot check"** of **the manufacturer's** work.”

Supra at 816, 817. See generally 14 CFR part 21 Subpart B-Type Certification



Significant Quotes from U.S. v. Varig

“By regulation, the FAA has made the **applicant itself responsible** for conducting all inspections and tests necessary to determine that the aircraft comports with FAA airworthiness requirements.”
Supra at 805. (14 CFR §§ 21.21(b) and 21.35.)

“The **applicant** submits to the FAA the designs, drawings, test reports, and computations necessary to **show** that the aircraft sought to be certificated satisfies FAA regulations.”
Supra at 805. (14 CFR §§ 21.17 and 21.21(a)(b).)

“If the **FAA finds** that the proposed aircraft design comports with minimum safety standards, it signifies its approval by issuing a type certificate.”
Supra at 806. (49 USC 1423(a)(2), 14 CFR §§ 21.21.)

Show Vs. Find

- The FAA has the authority to decide how much spot checking it must do in order to “Find” compliance
- If the FAA chooses it can perform a 100% review
- When do we do that?
 - Accident investigations, Special Certification Reviews, DDS Audits
- Contributing factors for a DER deciding to do a 100% review?
 - Applicant/Developer Software Certification Experience
 - Applicant/Developer Demonstrated Development Capability
 - Complex personnel work allocation structure
 - Applicant/Developer Software Service History
 - Complexity, Novelty, Alternate Means
 - Designee Capability



Show Vs. Find

- The point is, if the FAA chooses to do a 100% review the applicant should already have done that as a SHOW compliance activity.
- It should never be the case that the FAA does more reviewing than the applicant.
- Applicant SHOW compliance activity should assume the FAA will do an 100% review.

In describing “Showing” the court in Varig stated:

“By regulation, the FAA has made the applicant itself responsible for conducting all inspections and tests necessary to determine that the aircraft comports with FAA airworthiness requirements.”

Supra at 805. (14 CFR §§ 21.33 and 21.35)

“Show” Compliance (via US vs. Varig)

By regulation, the FAA has made the applicant itself responsible for conducting

- all inspections and tests (reviews and tests)
- necessary (enough to show a requirement is actually met)
- to determine that the aircraft (only things which effect aircraft safety)
- comports with (in accord with, in harmony without dissension)
- FAA airworthiness requirements.
(AC20-115B identifies DO-178B as a means)

Note: AC20-115B does not say DO-178B objectives only

“Show” Compliance

“Here is all the data. Look at as much as you want.”

- This is asking the FAA to show compliance.

“Here is all the data. And here is all the work we did to make sure it meets the regulations.”

- The FAA can review the evidence of compliance to find that it was done correctly.
 - Applicant Shows
 - Cert plans, analysis, tests, compliance reports
 - FAA Finds
 - Approved data, TC

DERs too

“Subject to regulations, supervision, and review the Administrator may prescribe, the Administrator may delegate to a qualified private person....”

Title 49 USC § 44702(d)(1) (also see US vs. Varig and FAA Order 8100.8b Ch 1 Par 6a)

Caveat:

While designees may be authorized to do most things that an FAA employee may do, they are not authorized to “exercise discretion” as are employees. Designees must make finding based on standards provided by the FAA. They do not have the legal authority to approve an item that does not meet the standard provided by the FAA. If the standard is not provided for in a statute or regulation, an FAA employee may have the “legal authority” to exercise discretion. This may be a fine distinction but it is an important legal distinction. Exercising governmental discretion is inherently governmental and may not be delegated to a non-governmental entity. FAA Legal (FT Worth)

Two Types of Show Compliance

In reality there are two types of show compliance:

1. Enough data exists so the FAA can make a finding and grant a TC.
2. Enough data exists to be found “not liable” in court.



Example: Swissair 111

2 September 1998 Swissair 111 crashed due to in-flight fire

Accident investigation showed a noncompliant cabin entertainment system installation even though

- Applicant showed compliance
- FAA found compliance

Accident related lawsuits included the following parties:

- Swissair (operator - out of business)
- Interactive Flight Technologies Inc. (supplied the system)
- Hollingshead International (system integration engineering)
- Santa Barbara Aerospace (STC applicant - out of business)

How Do You Show Compliance?

Enough to get TC Or Enough to not be liable

ACOs have the authority to decide how deep to look into the data to grant a certificate

The rest of this presentation assumes the applicant:

Wants a certificate And Wants to not be liable

However, applicants can choose to “accept the risk”

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Converting Guidance into Show Compliance Evidence

- Congress gave FAA authority to Prescribe:
 - Regulations, Standards, Procedures
- To determine Compliance, interpret standards the same way as regulations.
- Show each section, paragraph and sentence.
- Compliance with Advisory Circulars, Issue Papers, Policy Memos, are one of the best ways to ensure compliance. Deviations are to be proposed, and will be considered on a case by case basis.



Every Word?

- If the agreement is not complied with
then the FAA has no obligation to issue a TC
- If you want to do something different:
 - Alternate means of compliance
- Examples:
 - DO-160D
 - HIRF Users Guide
 - Aircraft Wiring (AC 43.13-1b Chapter 11)
 - DO-178B

What is the point?

If you are going to deviate at all from a documented accepted approach

1. The FAA is not obligated to accept it
2. Get it agreed to early in the program



What Does DO-178B Say?

- Section 1.0 Paragraph 1

The purpose of this document is to provide guidelines for the production of software for airborne systems and equipment that performs its intended function with a level of confidence in safety that complies with airworthiness requirements. *These guidelines are in the form of:*

- *Objectives* for software life cycle processes.
- Descriptions of *activities* and *design considerations* for achieving those objectives.
- Descriptions of the *evidence* that indicate that the objectives have been satisfied.

- Section 1.4 Paragraph 1 bullet 4

This document states the objectives for the software levels, as defined in paragraph 2.2.2. Annex A specifies the variation in these objectives by software level. *If an applicant adopts this document for certification purposes, it may be used as a set of guidelines to achieve these objectives.*

What About the Job Aid?

The Job Aid is a tool to
FIND compliance

We have been discussing
SHOW compliance

How have we found compliance?

- Each DER does their own thing all based on DO-178B
 - Common approach
 - Read 178B a bunch of times
 - Find something you don't like while reviewing data
 - Go back to 178B to identify why you didn't like it
 - If it can be linked to 178B text = finding
 - If not =observation
- 66 objective checklist
 - Ensured a look across the development
- FAA JobAid
 - Tripled the things to look at across the development
 - Spread across 4 different times during development



How have we shown compliance?

- “The DER didn’t find anything, therefore we showed”
- 66 objective checklist
- FAA JobAid

This has not exactly been in keeping with applicant’s responsibility (= liability)

The FAA has used its authority to not look too deeply into the software SHOW compliance data.

Why the emphasis now?

- Software is no longer a new technology for Aviation
 - We should know what we are doing by now
- Aviation work is growing
 - Software is in everything on modern aircraft
- FAA is shrinking
 - AVS is undergoing a workforce reduction due to budget cuts
 - Software DERs are still rare compared to other disciplines
 - The number of DERs cannot meet the demand
- Industry is looking to expedite FAA involvement



Who is supposed to do all that?

DO-178B section 8.0 paragraph 2

“The SQA process assesses the software life cycle processes and their outputs to obtain assurance that the

- objectives are satisfied,

that

- deficiencies are detected, evaluated, tracked and resolved,

and that the

- software product and software life cycle data conform to certification requirements.”

So a DER/FAA finding against development is also a finding against QA for not catching it first!

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Disclaimer

Remember the assumption is the applicant:

Wants a certificate

And

Wants to not be liable

Some of you will love this

Some of you will hate it

Some of you are already doing it

Purpose: to encourage best practices because -

We (FAA, DERs, engineers) take pride in our work. We protect the public from physical disasters, and we would very much like to protect the industry from financial disasters.

Where to start?

178B gives a hint:

5.5 Traceability

Traceability guidance includes:

- a. **Traceability between system requirements and software requirements** should be provided to enable verification of the complete implementation of the system requirements and give visibility to the derived requirements.

Traceability

Isn't Certification a requirement?

Aren't the regulations "airworthiness requirements" upon the system?

When you commit to doing DO-178B then aren't you essentially turning every "should" into a "shall"?

Show Compliance Solution:

- Identify every requirement in DO-178B
- Give them each unique requirement numbers
- Trace each requirement into your **PROCESS**

QA verifies compliance

(Practice what we preach)

Does anyone already do this?

For years many companies have included in their PSACs a traceability matrix between DO-178B objectives and what documents they are satisfied in.

Other companies will during the planning phase take the JobAid and identify each document necessary to answer each question.

100% compliance takes the next step which a few companies are already doing.

Developing a 100% Compliance checklist:

1. Look at each paragraph in DO-178B.
2. Decide if this is guidance or not (can you audit to it).
3. Decide if it should be broken up into multiple requirements.
4. Assign unique requirement numbers.
5. For each requirement ask:
 - Where have we planned for this?
 - Where do we accomplish it?
 - Where do we verify it?
6. Decide which DO-178B objective this question contributes to satisfying to determine leveling.
7. Some will not be required for certification, are they worth doing anyway?

Example: DO-178B Section 4.2, 1st Paragraph bullet .h

h. If deactivated code is planned (subsection 2.4), the software planning process should describe how the deactivated code (selected options, flight test) will be defined, verified and handled to achieve system safety objectives.

- Guidance? Yes
- Conditional? Only if using deactivate code

Rephrase into an audit item:

- If deactivated code is planned, do the software plans describe the process to define, verify and handle the deactivated code in order to achieve system safety objectives?

DO-178B Section 04.2 Paragraph 1.h

Planning for deactivated code

Where have we planned for this?

- Company standard for making software plans

No objective applies, not required for certification.

Company to decide if a business case justifies developing planning standards?

Where do we accomplish it?

- PSAC, SDP, SVP (SCMP?, SQAP?)

A-01-06 Software plans comply with this document. 4.1f, 4.6 level ABC

Where do we verify it?

- SQA Records (PSAC, SDP & SVP reviews)

A-01-06 Software plans comply with this document. 4.1f, 4.6 level ABC

- SQA Records (process compliance review)

A-01-04 Additional considerations are addressed. 4.1d level ABCD

Evidence of Compliance

You end up with:

- Documented rationale for every paragraph of DO-178B and how your company addresses each item.
- Ready made review check lists for each data item
- Conditional criteria which lets you customize the guidance for your program.



Illustration

Consider checklists addressing only chapter 11 & 12

- 11.1 to 11.20 = 138 questions
- 11.0 for each data item (8×20) = 160 questions
- Chapter 12 = 291 additional consideration questions
- = 609 checklist items

One 100% activity developed total number of questions

Level	A	B	C	D
No Additional Considerations	779	778	756	604
All Additional Considerations	1125	1124	1102	945

You are probably already doing most of this, the number just looks big.

How does it Compare with The Classic “Find”?

Classic find compliance approach

- All findings are linked to 178B text
- Keep looking until you are satisfied (warm fuzzy inside)

100% compliance approach

- All 178B text is lined to evidence of compliance
- Defined completion criteria

Any DER finding should already have “show compliance” evidence.

Not much different than what a thorough DER is already doing except ensuring nothing was overlooked.

How does it Compare with The JobAid?

- **FAA JobAid**
 - **JobAid is not a Checklist**
 - ~190 tasks to perform but One Task can include hours of work
 - Still need to link to 178B to classify as a finding
 - Defined completion criteria
- **100% Compliance**
 - All 178B text is lined to evidence of compliance
 - Defined completion criteria

Any JobAid finding should already have “show compliance” evidence.

Not much difference in effort except ensuring nothing was overlooked.

How does it Compare with The 66 Objectives?

- Every objective has a link back to the text
 - Many of those links have cross references to other sections
 - Not all sections are referenced
 - Sect 2.1.1 Sect 2.1.2 Sect 5.1.2 Para 3
 - Sect 7.3 Para 2.a Sect 8.2 Para 1.a etc.
- Not all objectives are listed in annex A
 - 7.1 identifies 8 CM objectives but table A-8 only has 6
- Therefore, it is possible to satisfy annex A and still have not met all of DO-178B

Where is the Value

1. Going through the exercise itself is a great tool to improve company understanding of DO-178B
2. Proper Prior Planning Prevents Poor Performance
3. Minimizes possible findings:
 - Should never be another finding that something was missed
 - May still be findings about how something was accomplished
4. Encourages standardization across programs
5. Encourages documented engineering work procedures to reduce incorrect work
6. Makes Cert Liaison activity much less time consuming.
 - An ACO conducted an SOI 1 in one hour because of good solid show compliance work



What about Scope?

The phrase “100% compliance” was used intentionally to describe 100% of DO-178B was complied with. Scope is the next question.

- 100% FIND compliance = evidence has been found that all of DO-178B was complied with
 - E.g. Code review checklist is reviewed by DER and a few code reviews are checked for correct use.
- 100% SHOW compliance = every piece of data in the project complies with all of DO-178B
 - E.g. Code review checklist is reviewed by SQA and verifies every code review used it and a sampling (based on level) are checked for correct use.

Summary

- The FAA's authority to generate policy is the same authority to generate regulations (directly from congress)
- True compliance with FAA publications is either complete or through alternate means of compliance
- SW DER field is understaffed, and the FAA is downsizing
- If the industry wants to keep their schedules
 - then they need to make the finding of compliance easier and faster to accomplish
- FAA is committed to do our best to not delay your programs
 - We may be forced to depend more on solid evidence of showing compliance then looking at data
 - We are willing to delay one schedule in order to meet many



References

- US Code (available at <http://uscode.house.gov/download/download.php>)
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(available at http://www.faa.gov/regulations_policies/faa_regulations/)
- FAA Order 2150.3a Compliance and Enforcement Program Dec 14, 1988
- FAA AC 43.13-1b Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair (Chapter 11)
- U.S. Supreme Court - United States V. Varig Airlines, 467 U.S. 797 (1984)
(references in italics have been updated to represent current policy)
- Garvey, FAA v. NTSB and Richard Lee Merrell, 190 F. 3rd 571, 577 (D.C. Cir. 1999).
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